

the biological characters of the staphylococci pathogenic for man, and tests that will be useful for their differentiation are described.

It will thus be seen that the report contains matter of considerable scientific and practical interest, and it would be a great pity if this work were to be discontinued in the future, as has been rumoured it may be.

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MENDELISM AND SEX.¹

ALL science is founded on observed facts. All authenticated facts, no matter how observed, are valuable to science. Many invaluable facts cannot be observed without the aid of some special method, for example, experiment; but, of the total mass of facts garnered by science, data furnished by experiment form a very small part. Therefore to rely solely on experiment is to put on blinkers.

Since species are able to exist in their environments, they are adaptational forms. The more minute our knowledge of a species, the more certainly are we able to assign past or present utility to nearly all its structures and faculties. Adaptation extends deeper than structures and functions. Variability itself is adaptive. A greater or lesser degree of variability is a variation and material for natural selection. There is satisfactory evidence that the average degree of variability displayed by every species and structure is controlled by selection. The mass of variations are "spontaneous." Thus there are hundreds of human races and diseases, and every race is resistant to every lethal disease in proportion to its past experience of it. Therefore in this case there is adaptation. Therefore it is clear that the poisons of disease, no matter how virulent or universally experienced by the race, do not cause alteration in the germ-plasm, and consequent racial degeneration. On the contrary, since adaptation has occurred, it is plain that variations are spontaneous, and, since diseases are so many, that they occur all round the specific mean. But some races (*e.g.* European dogs in India) have been known to degenerate when removed to new environments, where the native races flourish. Therefore the insusceptibility of the germ-plasm to the direct action of the environment has been established by natural selection, and this, combined with the facts that (1) species tend to become more variable a few generations after removal from ancestral environments to which they have become closely adapted, and where, therefore, nature limits variability; (2) the degree of variability in functionally correlated structures (*e.g.* pairs of limbs) tends to be correlated; and (3) the greater the need for adaptation the less is the degree of variability when once adaptation has been attained (*e.g.* head and fore-foot of squirrels as compared to tail), affords plain evidence that variability is under the control of natural selection.

When cessation of selection as regards any character occurs, that character tends to retrogress. Therefore retrogressive variations tend to predominate over progressive variations, whereby, without an increase of mortality, species are rid of redundancies, both useless variations and old-established parts which have become useless. Since this tendency to retrogression is highly adaptive, the presumption is that it is an adaptation. That the retrogression which follows panmixia is not due to reversed selection is shown by the fact that, though variations favourable against all diseases occur in every human race, yet they retrogress unless preserved by selection, for races become resistant only to those diseases to which they are exposed.

The two central doctrines of Mendelism are:—(1) segregation of units, and (2) independent inheritance of characters. Taken by itself, the doctrine of segregation assigns no function to conjugation. It merely controverts the doctrine of blending. Taken with the doctrine of independent inheritance, it assigns to conjugation the function of effecting an exchange of germinal units between the two sets of parental units. That much Mendelism implies—that much and no more. Mendelians believe,

apparently, that they have found the key to all the problems of heredity; but obviously Mendelism is concerned with nothing more than the function of conjugation. No other problem of biology with which it is concerned can be thought of. However grandiose the language used by its adherents, they are quite unable, when challenged, to indicate any other.

Mendelian inheritance is common when varieties which have arisen under artificial selection are crossed. It is comparatively rare when natural varieties (*e.g.* human) are crossed. Blending is then the rule. Latent traits, also, are commonly revealed by the crossing of artificial varieties. In the whole range of biological literature, no instance is recorded of a latent trait being revealed by the crossing of natural varieties. Even when artificial varieties are crossed, they never revert beyond the wild variety; that is, they never reveal traits that were latent in the wild variety. Presumably, therefore, characters become latent only under artificial selection, and consequently Mendelism is concerned, not with the main problem of conjugation, but only with certain anomalies which occur under conditions of artificial selection.

It is admitted on all hands that artificial selection is founded mainly on mutations, and that the inheritance of mutations tends to be alternative. It is admitted that the inheritance of fluctuations tends to be blended, and the evidence is conclusive that natural selection builds on fluctuations. Thus varieties are most numerous when mating individuals (*e.g.* birds) are enabled by good powers of locomotion to interbreed over a wide area. No interpretation of these facts save that of blending can be thought of. Human varieties, for example, arise only under conditions of geographical isolation. It has been said, on the evidence of half-a-dozen generations, that mutations are stable, and having arisen can be eliminated only by selection. This implies that only progressive variations occur in nature, and therefore that no structures ever disappear or retrogress except through reversed selection; but though variations favourable against all diseases occur in all human races, only those which are selected are preserved and contribute to evolution. Therefore it is clear that the rest retrogress, though there can be no reversed selection in this case.

When species are sexually dimorphic, mating individuals differ, as a rule, little in non-sexual characters, but much in sexual characters. Offspring reproduce *either* the paternal *or* the maternal sexual characters. That is, the *reproduction* of sexual characters is alternative, the male and female characters being "allelomorphic" to one another. But the *inheritance* of them is not alternative, for each sex inherits the characters of the other in a latent state, as is proved by a mass of evidence. Therefore, though in bi-parental reproduction there is apparently no blending as regards the sexual traits, yet the fact is that the patent characters of the one sex blend with the latent characters of the other. Sometimes the male characters are latent for a long series of generations, as in aphides, or apparently permanently, as in *Cypris reptans*. A mutation, like a sexual difference, is a large difference, and when an individual mutates and mates with the parent type, the *reproduction* of the mutation tends to be alternative. But the evidence is massive that the *inheritance* is not alternative, but, on the contrary, that the mutation is latent in those lines of descent which follow the parent type, whereas the ancestral trait is latent in those lines which follow the type of the mutant. Like the sexual traits in bi-parental reproduction, the recessive is temporarily latent in the impure dominant. Like the male characters in aphides and *Cypris reptans*, it is more or less permanently latent in "pure" dominants, as is the dominant character in the recessive. This is proved by the occasional occurrence of recessives in lines of "pure" dominants, and *vice versa*. It is even more decisively proved by the reproduction of latent ancestral characters, especially when (artificial) varieties are crossed. Cuénot's theory of colour factors attempts to interpret in Mendelian terms this fact of the reproduction of latent ancestral traits, but his hypothesis totally fails to account for the reappearance of latent ancestral traits in pure lines of descent, as, for example, when an aged female bantam reproduces, not the secondary male characters of her own variety, but those of an ancestral type. Here there can

¹ Abstract of a paper read before the Linnean Society on December 19, 1907, by G. Archdall Reid.

have been no antecedent separation of factors. Therefore the evidence is that mutations tend to be inherited in the mode of sexual characters. There are, however, differences. Sexual characters tend to alternate more perfectly, to cohere together in their respective sets more closely, and to have a lesser tendency to blend with their opposite numbers than Mendelian characters; but this is only what might be expected, for the mode of inheritance for sexual characters has been established by stringent selection. Some sexual characters, however, sometimes blend or change places with their opposite numbers, as in so-called human hermaphrodites; the dominance of some Mendelian characters is very imperfect; reciprocal Mendelian crosses sometimes produce unlike results; and the inheritance of some Mendelian characters (e.g. colour-blindness) is sexual. Were their occurrence the rule, not the exception, we would speak of them as sexual characters. Properly speaking, Mendelian characters are non-sexual traits which are reproduced in the sexual mode. If, however, we examine any list of so-called Mendelian characters, we find that the majority may fairly be described as secondary sexual characters, though not necessarily as sexual differences, for example, colour and form of plumage. It seems clear, then, that there is no real segregation, no real alternative inheritance, but only alternative reproduction, alternative patency and latency. Therefore blending is universal. Unless the reappearance of ancestral traits can be explained, the bottom falls out of the Mendelian hypothesis. Nevertheless, Mendelian facts are very valuable, inasmuch as they indicate the difference between natural and artificial selection. The experimental observer is able to note only large differences between mating individuals. In practice, he has almost limited his materials for study to domesticated varieties. He has altogether ignored fluctuations. Hence the mutation and Mendelian theories.

It is possible that mutations are more common amongst artificial than amongst natural varieties, in which the range of variability is more stringently limited. But amongst the entirely natural varieties of the species we know most intimately (man) mutations are common enough, and their reproduction tends to be Mendelian. But all are so injurious in the struggle for existence or for mates that when possible they are treated surgically. Never yet has a useful human mutation been recorded. Man has a written history of thousands of years, and human varieties differentiate whenever geographical isolation is sufficiently complete and prolonged. Men are fond of noting wonders. But, notwithstanding the immense range of material, never yet has the origin of a human variety by mutation been recorded. It is easy to conceive of evolution as resulting from mutations when we limit our materials of thought to the colours and shapes of flowers and leaves of plants which are preserved under human care. It is not so easy to think of it as founded on mutations when we take into account the exquisitely co-adapted internal parts of a complex animal, amongst which a mutation would have the same effect as one occurring in one of the parts of a watch.

The extreme instability of fluctuations has been noted and has furnished a main argument to the supporters of the mutation theory. There is abundant reason for believing that in a blend the retrogressive character tends to predominate. Thus racehorses degenerate unless carefully selected. Suppose a country in which malaria is prevalent and another from which it is absent. In the former, variations favourable against malaria are selected; like mates with like; therefore blending causes little or no retrogression, and the mean of the race is raised in each generation. In the latter, though favourable variations occur, unlike individuals mate; therefore blending causes retrogression, and the race is rid of a useless redundancy. Apply this reasoning to all variations and all characters, and the function of conjugation becomes apparent. It is, in effect, a selective agent of retrogression. Selection rough-hews the type; retrogression chisels out the finer lines. Reproduction is bi-parental in all the higher and more complex forms in which nature's task of closely adjusting the numerous co-adapted parts is most difficult.

If we accept the theory of blended inheritance, we are able to assign a useful function to conjugation. But to

both the Mendelian and the mutationist, sex is a phenomenon to be explained away. According to the former, conjugation merely jumbles together elements which may be incongruous. According to the latter, conjugation is nothing other than an obstacle to the survival of mutations, which have the best chance of surviving when reproduction is parthenogenetic. It has been said by some Mendelians and mutationists that fluctuations are due merely to temporary effects of nutriment, temperature, and the like; mutations alone are permanent. How, then, is it possible to explain the fact that when reproduction is parthenogenetic "thousands of forms may be cultivated side by side in the Botanical Gardens, and exhibit slight but undoubted differentiating features, and reproduce themselves truly by seed" (de Vries)? This does not happen when reproduction is bi-parental. It can hardly be contended that mutations are a thousand-fold more numerous when reproduction is parthenogenetic than when it is bi-parental. We are driven to the conclusion that the fluctuating nature of fluctuations when reproduction is bi-parental is due to the retrogression caused by blending. The seeming permanency of mutations is due to their mode of reproduction. They take longer to retrogress than fluctuations only because they are bigger. All latent characters, since they are not selected, tend to retrogress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. ADOLPHE CARNOT, latterly director, and for many years professor, of chemistry at the Paris School of Mines, has retired with the title of honorary director of the school.

It is announced, says *Science*, that Mr. Emile Berliner, of Washington, the inventor of the gramophone, has given 2500l. as endowment of a research fellowship for women who have demonstrated their ability to carry on research work in physics, chemistry, or biology.

A RESEARCH scholarship or scholarships, founded by Mr. Andrew Carnegie, will be awarded shortly, irrespective of sex or nationality, on the recommendation of the council of the Iron and Steel Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the secretary of the institute, 28 Victoria Street, London, S.W. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry.

THE sixth annual meeting of the North of England Education Conference was opened at the University of Sheffield on January 3, under the presidency of Prof. M. E. Sadler. After the presidential address, Prof. Hicks read a paper on the function of a modern university, and Dr. R. H. Crowley (Bradford) and Dr. Clement Dukes (Rugby) dealt with medical inspection of school children. Other subjects discussed were holiday and open-air schools, compulsory attendance at evening schools, and the teaching of history. On the following day Sir William Clegg presided, and the morning sitting was devoted to consideration of the work of training colleges. The afternoon topics were:—(1) the treatment of defective children; (2) house-craft in girls' schools; (3) artistic perception in children.

THE London County Council Conference of Teachers was held on January 2, 3, and 4, when more than 1200 visitors signed the attendance book, and as this was the tenth of these annual meetings, it is clear that their utility is appreciated. With a wise liberality, the County Council promises to send a verbatim report of the proceedings to those who attended the conference, of which a noteworthy feature was the frank cordiality with which the Council inspectors and teachers interchanged views. The principal topics discussed were the place of nature-study in the curriculum, the study of botany by girls, the commercial education of boys, manual instruction for young children, practical suggestions for school library management, and recent pedagogic experiments in the study of literature and of open-air geography.